CKJG Technical Updates

Cawangan Kejuruteraan Jalan & Geoteknik

Bulletin on lessons learnt in
- Road Safety
- Road Engineering
- Geotechnical Engineering

Theme of the month:

INNOVATION OF PILES IN MALAYSIA

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DRILL PILES

The drill piles or screw piles with helicoid wing at the bottom for screwing into the ground are widely used in many countries such as Japan, Australia and also in Europe. This type of pile can take higher load capacity compared to a straight pile, length for length. Drill piles system is an environmental friendly method that generates minimal noise, vibration and waste soil. Its easy and rapid installation gives more advantages to the system. As the construction industries grow, drill piles may become the new innovation that can be adapted to the projects in Malaysia.

1.0 Introduction

Drill piles or screw piles have been used in construction for over 200 years. It became one of the greatest types of foundations used throughout the world. It is an alternative solution to the geotechnical problem arises especially for subsurface conditions.

Most historians agree that drill pile foundations were introduced as a full-scale practical foundation system by Alexander Mitchell (1780-1868), an Irish builder and brick manufacturer. The concept of drill piles by Mitchell as early as 1831 was to solve the problem of providing good foundations for lighthouses in soft soil. One of it had been used for Sands Lighthouse which was located at very unstable bank near the entrance of the river in England. There were several other constructions using drill piles especially in construction of lighthouses in Virginia, Florida and other states.

This "emerging technology" was imported to Australia in 1872 and used to build the "Cape Jaffa Lighthouse" erected to alert ships of the Margaret Brock Reef off the South Australian coast. The oldest known functioning drill piles structure in Australia is the Victor Harbour Jetty, known as the "Screw Pile Jetty" in South Australia which was built in 1881. Similarly in India, the drill piles were used in piers and railway bridges and associated structures. In the late 1800's Japan also began utilising the drill piles for similar applications.

2.0 Technical Properties of Drill Piles

In modern geotechnical practice, the design of drill pile foundations considers all of the factors mentioned by Mitchell such as the geometry of the pile including size and shape of the shaft, diameter of the spiral and number of spiral disc as shown in **Figure 1**, the depth of the installation, and the soil characteristics at the site.

The number and sizes of the helixes is a function of the soil profile, with deep firm clay profiles requiring large plates and used of 2 to 3 helixes. This reduces the depth that the pile would have to go, with conventional piles having to penetrate deeper into the profile as constructions in **Figure 2**. This "gearing" principle gives the drill piles considerable design flexibility. Shallower soil profiles over rock would require a small single helix plate.

The number of helices, diameters and position on the pile shaft as well as steel plate thickness are all determined by a combination of: -

- The combined structure design load requirement
- The geotechnical parameters
- Environmental corrosion parameters

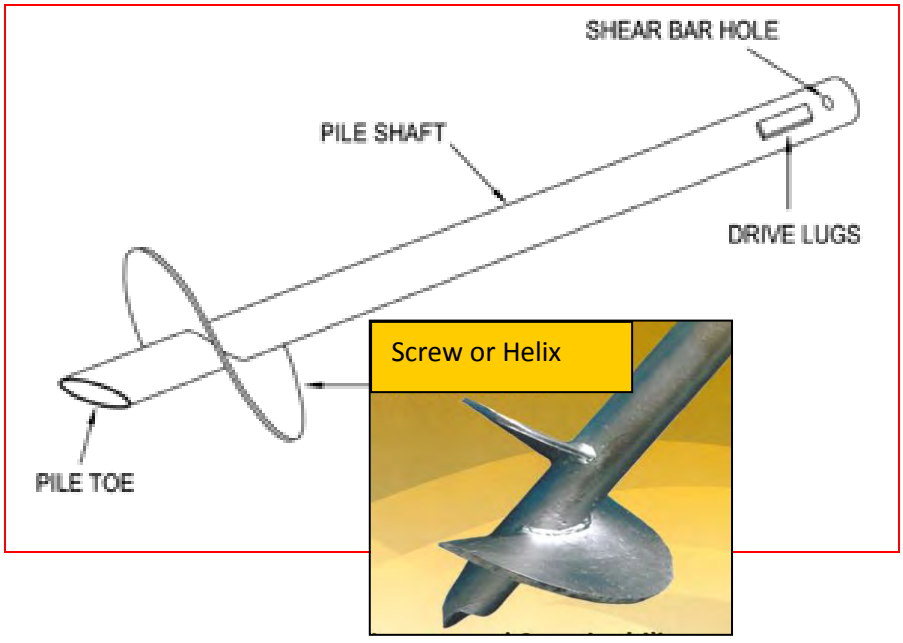

Figure 1: Drill Piles

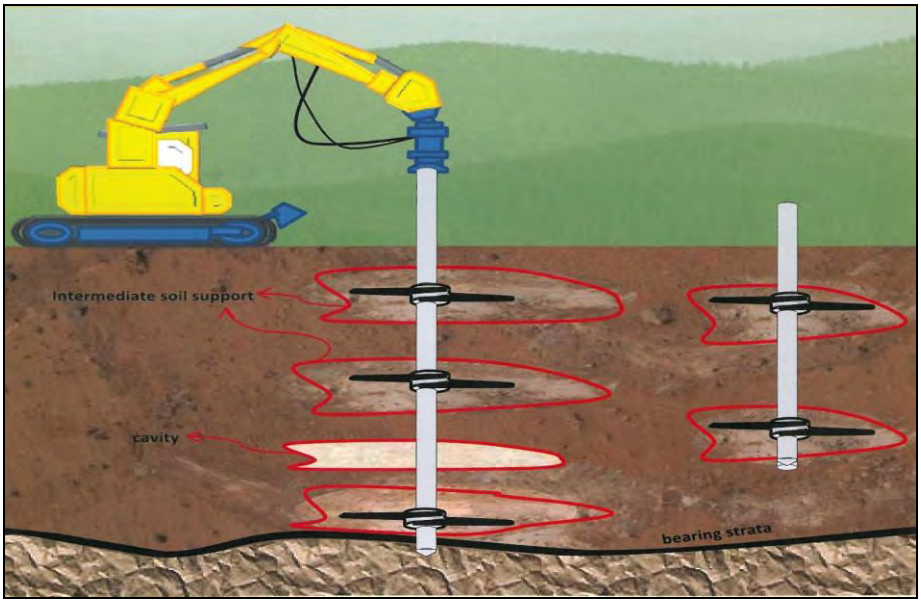

Figure 2: Construction of Drill Piles

3.0 Application of Drill Piles

In Australia since the early 1990's, drill piles have been used extensively across the country in compressive, tensile and lateral load applications in new domestic and commercial buildings and structures. They are used in civil applications, as well as underpinning existing buildings. Generally, applications of drill piles are: -

a) Medium Rise Building

- Education Institution
- Low Density Multi-storey Dwellings
- Commercial Development
- School

b) Compression – Tension pile requirement

- Jetty as shown in **Figure 3**
- Advertisement Signboard as shown in **Figure 4**
- Wind Resisting Structure
- Earthquake Resisting Structure

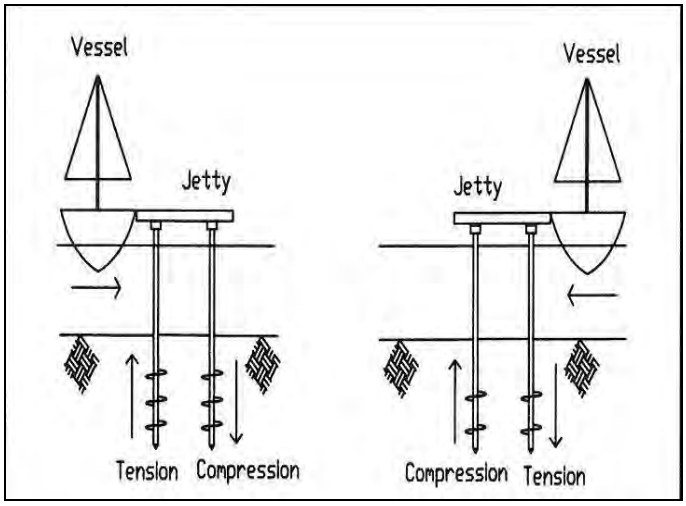

Figure 3: Drill Piles for Jetty

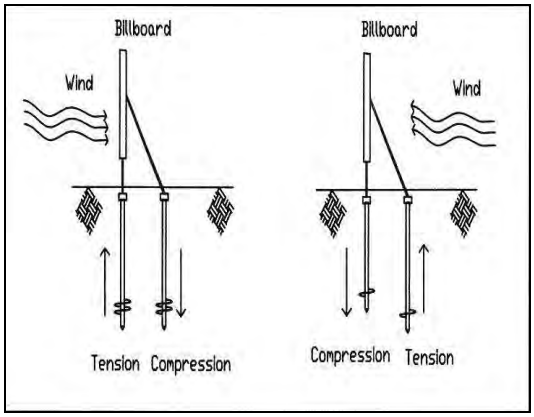

Figure 4: Drill Piles for Billboard

c) Infrastructure

- Pipeline Buoyancy
- Transmission Tower
- Utility Pole
- Bridge

d) Slope Stabilisation

e) Earth Retaining System

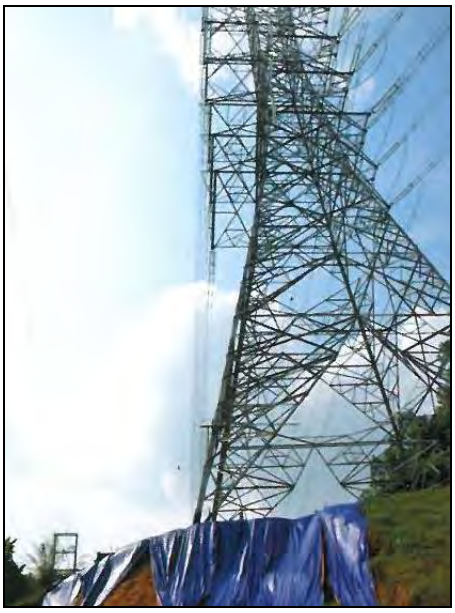

Figure 5: Drill Piles for Transmission Tower Foundation

4.0 Advantages of Drill Piles

Drill piles are one of the most cost effective foundation types available in the domestic and commercial construction industry. They are also the most rapid in installation, as well as causing the least disturbance to the soil profile during installation and eliminating the removal of spoil.

Drill Piles provide foundation solution in both tensile and compression mode and can be used immediately upon installation. It is innovative and able to harness full natural soil capacity resulting in greater engineering efficiency hence economical. The other advantages of Drill Piles are: -

i) Low vibration/noise

ii) No dewatering necessary

iii) Versatile installation process with easy manoeuvre

iv) Can be installed in tight workplace such as narrow gaps, limited headroom and congested areas as shown in **Figure 6**

v) Can be installed at any direction-in soft soil, cavity soil condition without caving in of drill holes

Figure 6: Drill Piles can be installed in tight workplaces

5.0 References

1. Howard A. Perko. 2009**. "***Helical Piles – A Practical Guide To Design And Application*". America. John Wiley & Sons, Inc.
2. http://www.drillpile.com

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